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From the Editors

Apology

The photograph of a drinking echidna, reproduced on the front cover of the February 2015 issue of *The Victorian Naturalist*, was attributed inadvertently to Vivian Bounds. It was in fact taken by Wendy Higgs. We apologise for this error, which was due to an oversight on our part.

New records

The editors are always pleased to be able to publish first records of species, detected during field-work. In this issue of the journal we are able to do it twice in widely different environments, with papers focusing on the sun moth in New South Wales and crawling medusa in coastal Victoria. Of course, publishing sightings of species in localities in which they have not previously been recorded is a matter of some importance. As well as extending the general knowledge relating to the occurrence of these species, such reports provide data that can be considered in a range of future strategies and plans for the management of the relevant environments. Michael and Alexander's paper on the Inland Python, although not a first record, addresses the importance in such circumstances of having a detailed understanding of where particular species are likely to be found.

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Front cover: Male Fat-tailed Dunnart *Sminthopsis crassicaudata*, Yarran Paddock, Terrick Terrick National Park. Photo John Harris, Wildlife Experiences P/L.

Back cover: Eastern Pygmy Possum *Cercartetus nanus*, Holey Plains State Park, Rosedale. Photo John Harris, Wildlife Experiences P/L.

Records of the Inland Carpet Python *Morelia spilota metcalfei* (Serpentes: Pythonidae) in the North East Catchment Management Area, north-east Victoria, and the implications for fire planning

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Abstract

A study to obtain records of the endangered Inland Carpet Python *Morelia spilota metcalfei* Wells & Wellington 1984 was conducted in the North East Catchment Management Area, north-east Victoria, between August 2010 and February 2011. A range of survey methods were used to procure recent and historical records. Interviews with resident landholders and staff from natural resource management agencies produced 27 python records from 18 new localities. Nineteen records were authenticated and eight records remained unconfirmed. Most sightings were made by resident landholders from the late 1960s to the early 1980s and originated from Mount Pilot, Burrowa-Pine Mountain, Mount Mittamatite, Mount Granya, Mudgegonga, Rosewhite and the Warby Ranges. These new localities should be considered in regional and statewide conservation planning for the species. Vegetation assessments at each location revealed an association with Granitic Hills Woodland (EVC No. 72), confirming that north-facing remnants and granite landforms are important habitat for the Inland Carpet Python in north-east Victoria, and warrant further protection. Fire planning in the upper Murray region should consider fire intensity and the seasonal timing of burns to reduce the risk of habitat loss and mortality. Key recommendations, based on the ecological requirements of the Inland Carpet Python, include implementing small-scale, low intensity fires during late autumn. (*The Victorian Naturalist* 132 (2) 2015, 36–43)

Keywords: Pythonidae, *Morelia spilota*, fire planning, granite landforms

Introduction

The Inland Carpet Python *Morelia spilota metcalfei* (formerly *M. s. variegata*) Wells & Wellington 1984 is one of two sub-species of python that occur in Victoria (Wilson and Swan 2013). The Diamond Python *M. s. spilota* occurs along the east coast of Australia, extending from Point Hicks in Victoria (approximately 100 km south of the Victorian border) to the northern rivers region of New South Wales (Swan *et al.* 2004). The Inland Carpet Python occurs west of the Great Dividing Range, extending from central Queensland to the Warby Ranges in Victoria (Coventry and Robertson 1991) and as far as the Eyre Peninsula in South Australia (Schwaner *et al.* 1988). Recently, Taylor (2005) identified high levels of gene flow among Carpet Python sub-species, suggesting morphological differences were due to local adaptations rather than genetic divergence among populations. These findings suggest that python populations in eastern Australia may no longer warrant sub-specific status.

The Inland Carpet Python occupies a broad range of vegetation types, including swamps, woodlands and forest (Wilson and Swan 2013).

In Victoria, the Inland Carpet Python occurs in River Red Gum *Eucalyptus camuldulensis* forest along the Murray River (Robertson and Hurley 2001), eucalypt woodland and Mallee vegetation types in western Victoria (Robertson *et al.* 1989), as well as granitic woodland such as the Warby Ranges near Wangaratta (Heard *et al.* 2004). In southern New South Wales, the Inland Carpet Python is predominantly restricted to large granite and metamorphic landforms (Michael and Lindenmayer 2008). The species is relatively catholic in its use of shelter sites, which include tree hollows, hollow logs, rock crevices, subterranean cavities, disused rabbit burrows (Heard *et al.* 2004), grain sheds and roof cavities (Shine 1994).

Anecdotal evidence suggests that Inland Carpet Python populations have declined over the last 100 years (Shine 1994; DSE 2003). Accordingly, the species is listed as endangered in Victoria (DSE 2013) and regionally endangered in the Western division of NSW (Sadlier and Pressey 1994; Sadlier 1994). Prior to this study, the Victorian Biodiversity Atlas contained 172

records of the species in Victoria (DEPI 2014), despite anecdotal reports of pythons being relatively common in the River Red Gum forests along the Murray River. However, in other parts of Victoria records of the Inland Carpet Python are scarce (DEPI 2014). For example, 19 records of the species exist in the North East Catchment Management Area (NECMA), and only two records exist within the upper Murray region, one from near Walwa and the other from the western slopes of Burrowa-Pine Mountain National Park (DEPI 2014).

This study aimed to procure additional records of the Inland Carpet Python in the NECMA, with particular focus on obtaining records and information on the habitat requirements of the species in the upper Murray catchment. Information collected in this study will be used to assist with fire planning in Mount Granya State Park, Mount Lawson State Park and Burrowa-Pine Mountain National Park (Michael 2011).

Methods

Study area

The study area included the NECMA in north-east Victoria, an area bounded by the Murray River in the north, the Victorian Alps in the south, the Warby Ranges in the west and the NSW border in the east. The area covers 1 957 000 ha and supports agriculture, forestry, tourism and manufacturing industries (NECMA 2011). The main bioregion in the area is the Northern Inland Slopes, a region characterised by floodplains, grassy valleys and undulating foothills. Historically, the Northern Inland Slopes supported a rich diversity of dry forest and woodland Ecological Vegetation Classes (EVCs), including large tracts of Box-Ironbark Forest, Granitic Hills Woodland, Herb-rich Woodland, Valley Woodland and Riverine Grassy Woodland. Many of these EVCs are now threatened by extensive clearing of native vegetation and habitat degradation caused by routine agricultural practices (<http://www.depi.vic.gov.au/>).

Survey protocols

Records of the Inland Carpet Python were obtained using a range of methods. These included:

- 1) Reviewing the Victorian Biodiversity Atlas database (<http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/victorian-biodiversity-atlas>), scientific and unpublished literature;
- 2) Placing an advertisement on the notice boards of general stores in the towns of Bellbridge, Bethanga, Walwa, Tintaldra and Cudgewa;
- 3) Conducting a letter drop to approximately 100 landholders along the Murray River Road;
- 4) Posting an article on the NE Landcare website www.northeast.landcarevic.net.au/news/carpet-python;
- 5) Publishing an article in *Odatria*, the online newsletter of the Victorian Herpetological Society http://vhs.com.au/wp-content/uploads/2011/05/Odatria_9_APR112.pdf;
- 6) Engaging in a community consultation process which included interviewing 11 long-term farmers (i.e. resident for more than 20 years) and seven new residents of 'small blocks' in the upper Murray catchment, particularly landholders between Bellbridge and Tintaldra. Long-term residents were visited based on recommendations by other landholders in the region;
- 7) Informal conversations with staff from natural resource management (NRM) agencies including the North East Catchment Management Authority (NECMA), Parks Victoria and Department of Environment and Primary Industries;
- 8) Conversations with colleagues and environmental consultants.
- 9) Informal conversations with landholders during a field day at Wise's Creek (Vincent's Reserve) Flora and Fauna Reserve, Talgarno;
- 10) Conducting a media release and interviews with Prime News, WIN News and Edge FM, Wangaratta in October 2010;
- 11) Publication of an article in the *Border Mail*;
- 12) Field surveys, involving 80 person hours searching for animals, sloughed skins or scats in Mount Granya State Park, Mount Lawson State Park and Burrowa-Pine Mountain National Park between October 2010 and February 2011.

Based on prior knowledge of the species' habitat (e.g. Heard *et al.* 2004; Michael and Lindenmayer 2008), field surveys targeted north-facing slopes within Granitic Hills Woodland and involved scanning logs, rocks and tree branches, inspecting tree hollows, hollow logs and rock crevices, and raking beneath shrubs and dense vegetation. During January, two nocturnal road

surveys were conducted along the Murray River Road between Bellbridge and Tintaldra (a distance of approximately 120 km).

To authenticate sightings, witnesses were asked to describe the details of their observation. They were then shown a series of pictures depicting different colour morphs, as well as images of other local snake species. Sightings were considered authentic if witnesses clearly recognised the species from the pictures or their descriptions conformed to 'typical' python behaviour (i.e. observed climbing or basking in trees, or observed with a 'rabbit-sized' bulge in the stomach). Where possible, the location of each sighting was visited, vegetation assessments were conducted and GPS co-ordinates recorded. Where second- or third-hand information was obtained, attempts were made to contact the original source. Records were classified as unconfirmed if the original source could not be contacted.

Results

The surveys procured a minimum of 27 additional Inland Carpet Python records from 18 new localities in the NECMA (Fig. 1). Nineteen records were considered authentic and eight records remained unconfirmed (Table 1). The majority of records were obtained via interviews with resident landholders and conversations with NRM staff. No records were obtained during field surveys of the large forest blocks. Most records obtained by resident landholders were from sightings of the species during the late 1960s to the early 1980s and originated from Mount Pilot, Burrowa-Pine Mountain, Mount Mittamatite, Mount Granya, Mudgegonga, Rosewhite, Glenrowan and the Warby Ranges (Table 1). The Mudgegonga and Rosewhite sightings, if authentic, represent significant range extensions.

Discussion

This study used a range of survey methods to obtain records of the Inland Carpet Python, with varying success. Survey results suggest that important historical information on distinctive rare species can be obtained by interviewing long-term landholders and staff from NRM agencies. Farmers who manage properties over many family generations often acquire valuable knowledge on the types of animals that

once lived on their properties. However, this knowledge is rarely documented or entered into wildlife atlas databases. Similarly, NRM staff members are frequently contacted by the local community with information of wildlife sightings, but again many sightings remain unconfirmed and undocumented. Records that cannot be positively identified should not be registered with the Victorian Biodiversity Atlas (VBA), as misidentified animals can cause potential problems with the quality of data that can be used in, for example, species distribution models.

The information provided in this study will be useful not only for fire planning in the upper Murray, but will be of particular value to public and private land managers interested in protecting (and potentially re-creating) habitat that is critically important to pythons and their prey. We obtained 18 new localities where the Inland Carpet Python had previously never been recorded in the NECMA (Fig. 1). Many of the new localities originated from the upper Murray region, and included areas such as Bellbridge, Mount Granya, Thologolong, Guys Forest, Corryong and Mount Mittamatite. In addition, new localities outside of the upper Murray region included Mount Pilot, Eldorado, Rosewhite, Mudgegonga, Lurg and Glenrowan (Table 1). These new areas should now be considered in regional and statewide conservation planning for the species. Python sightings at these locations have some features in common, namely aspect and geology. Vegetation assessments at each site revealed a strong association with Granitic Hills Woodland EVC. This EVC is therefore a critically important component of the species' habitat requirements in north-east Victoria, and concurs with similar findings from the Warby Ranges (Heard *et al.* 2004) and the South-west Slopes of NSW (Michael and Lindenmayer 2008). This study thus provides additional evidence to suggest that protecting remnants of Granitic Hills Woodland should be a high priority in conservation planning for this species.

Records from near Rosewhite and Mudgegonga suggest that the species occupied a much wider geographical range than is currently recognised. Interestingly, the authors are aware of several anecdotal records from further south, in the Goulburn Broken catchment. For example, on 4 November 2011, an adult Inland Carpet

Table 1. Annotated list of previously undocumented records of the Inland Carpet Python *Morelia spilota macleayi* in the North East Catchment Management Area, north-east Victoria (*Approximate locality only, derived from Google Earth based on eye witness accounts, NA = not available, bold type = known locality).

Locality	Latitude	Longitude	Elevation (metres)	Date	No.	Sighting details	Ecological Vegetation Class	Source
Corryong	Unknown	NA	NA	1960s	2+	Unconfirmed sightings on the Murray River floodplain and surrounding hills.	Granitic Hills Woodland EVC 72 and 295 (<i>E. blakeyi</i> , <i>E. albens</i> , <i>E. camuldulensis</i>).	Anonymous ex-resident of Corryong pers. obs.
Thologolong Station	35°59'17"	147°22'50"	260	1960 – late 1970s	4+	Regular sightings around property, several caught in rabbit netting, none after 1980.	Granitic Hills Woodland EVC 72 (<i>E. blakeyi</i> , <i>E. albens</i>)	Peter Sutherland pers. obs. (landholder)
Rosewhite	36°34'14"	146°55'04"	320	Jan 1963	1	Adult python observed crossing Happy Valley Creek 1 km from the Pinnacles.	Grassy Dry Forest (<i>E. goniacalyx</i> , <i>E. macrorhyncha</i> , <i>E. bridgesiana</i>)	Michael O'Sullivan pers. obs. (resident)
Eldorado*	36°18'21"	146°31'47"	200	1970	1	Unconfirmed adult python sighted near historical dredge.	Granitic Hills Woodland EVC 72 (<i>E. blakeyi</i>)	Anonymous landholder pers. comm.
North Wangaratta	36°19'56"	146°20'45"	145	1970s	1	Adult python sighted in a red gum tree in caravan park.	Riverine Grassy Woodland EVC 295 (<i>E. camuldulensis</i>)	Geoff Barrow pers. comm. (Ranger, Parks Victoria)
Thologolong*	35°57'32"	147°2'443"	284	1970s	1	Unconfirmed python observed in gully. The specimen was shot.	Granitic Hills Woodland EVC 72 (<i>E. blakeyi</i> , <i>E. albens</i>)	David Star pers. comm. (landholder)
Guys Forest 'Avondale'	36°04'03"	147°37'36"	440	1970s	1	Adult python injured in farm shed, taken to a vet and released elsewhere.	Farmland	Kelton Goynes pers. comm. (Ranger, Parks Victoria)
Upper Lurg*	36°33'44"	146°09'18"	364	1975	1	Adult python sighted near rabbit warren in granite country.	Granitic Hills Woodland EVC 72 (<i>E. blakeyi</i> , <i>E. albens</i>)	Jim Iambrell pers. comm. (resident)
Peechelba, Killawarra State Forest	36°11'11"	146°11'18"	180	1980s	1	Unconfirmed road kill on north side of Killawarra State Forest.	Box Ironbark Forest EVC 61 (<i>E. sideroxylon</i>)	Geoff Barrow pers. comm. (Ranger, Parks Victoria)
Mudgegonga*	36°29'39"	146°49'05"	310	1980s	1	Adult python observed descending a tree along Burwidgee Ck.	Grassy Dry Forest (<i>E. goniacalyx</i> , <i>E. macrorhyncha</i> , <i>E. bridgesiana</i>)	Anonymous landholder pers. comm.
Bellbridge	36°06'16"	147°03'24"	191	Early 1990s	1	Adult observed in tree adjacent to Lake Hume, 2 km south of Bellbridge.	Mixed tree planting (<i>Eucalyptus maculata</i> , <i>E. sideroxylon</i>)	Rob Fenton pers. obs. (TAFE Riverina Institute)

Table 1. continued.

Locality	Latitude	Longitude	Elevation (metres)	Date	No.	Sighting details	Ecological Vegetation Class	Source
Murray River Rd, Mount Granya State Park	36°03'38"	147°18'17"	227	Early 1990s	2	Separate sightings of adults in trees on north-facing granitic woodland south of Murray River Rd.	Granitic Hills Woodland EVC 72 (<i>E. blakeyi</i> , <i>E. albens</i> , <i>E. macrorhyncha</i>)	Rob. Fenton pers. obs. (TAFE Riverina Institute)
Burrowa–Pine* Mountain	36°00'06"	147°50'42"	650	1990s	2+	Unconfirmed sightings by bush walkers from the north-face near summit.	Granitic Hills Woodland EVC 72 (<i>E. blakeyi</i>)	Ian Davidson pers. comm. (ecologist)
Mount Mittamatite	36°08'54"	147°52'22"	900	1995	1	Unconfirmed adult sighted by R Hodge (retired DSE fire crew) near fire tower on the summit.	Granitic Hills Woodland EVC 72 (<i>E. blakeyi</i> , <i>E. goniocalyx</i>)	Kelton Goyne pers. comm. (Ranger, Parks Victoria)
Wangaratta, Warby Ranges State Park	36°15'27"	146°12'06"	290	1996+	2+	Several python sightings made during radio-telemetry study, e.g. Mount Killawarra.	Granitic Hills Woodland EVC No. 72 (<i>E. blakeyi</i> , <i>E. macrorhyncha</i>)	Geoff Barrow pers. comm. (Ranger, Parks Victoria)
Glenrowan	36°28'08"	146°13'58"	230	1998	2+	Adult python observed climbing tree in orchard, plus other unconfirmed sightings in area.	Granitic Hills Woodland EVC 72 (<i>E. blakeyi</i>)	Geoff Barrow pers. comm. (Parks Victoria)
Mount Pilot	36°14'58"	146°39'36"	400	2008	1	Adult sighted above Yeddonba rock art site.	Granitic Hills Woodland EVC 72 (<i>E. blakeyi</i> , <i>Callitris endlicheri</i>)	Donna Mitch pers. obs. (DSE)
Mount Mittamatite	36°08'54"	147°52'22"	900	2009		Unconfirmed python scat found near summit fire tower (Scat not verified by author)	Granitic Hills Woodland EVC No. 72 (<i>E. blakeyi</i> , <i>E. goniocalyx</i>)	John Silins pers. comm. (Ranger, Parks Victoria)
Glenrowan	36°27'50"	146°13'22"	240	2009	1	Road-killed adult (approx 3 m total length) sighted in town.	Township	Ian Davidson (ecologist) pers. comm.
Wangaratta, Warby Ranges State Park	36°18'49"	146°12'29"	320	2011	1	Road kill adult python along Wangandary Road Warby Ranges. Specimen lodged with Parks Victoria.	Granitic Hills Woodland EVC No. 72 (<i>E. blakeyi</i>)	Shaun Huguenin pers. comm. (DSE)

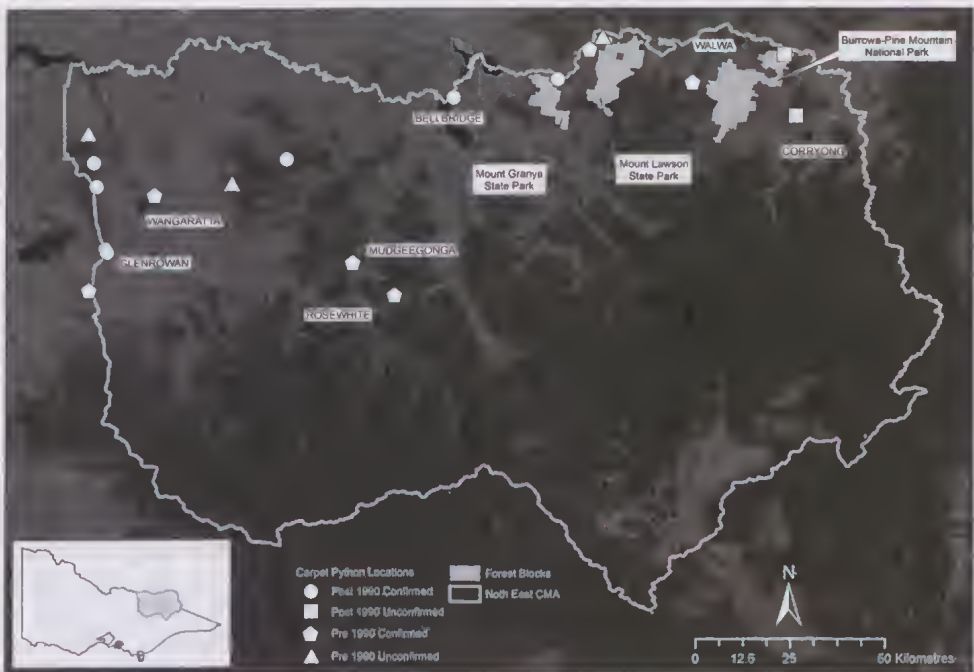


Fig. 1. Location of previously undocumented records of the Inland Carpet Python *Morelia spilota metcalfei* in the North East Catchment Management Area, north-east Victoria.

Python (presumably) was sighted from Swampy Riparian Woodland 1 km north of the township of Strathbogie (K Petrovic pers. obs.). Two unconfirmed python sightings also exist from near Ruffy. One sighting was from a chicken coop (S Sass pers. comm.) and the other, in October 2012, was from a granite outcrop near Mount Tickatory (J Morton pers. comm.). It is possible that pythons may still inhabit granite country as far south as Tallarook. However, given the lack of recent sightings from areas such as the Lurg Hills, it is likely that python populations have been fragmented for many generations, resulting in population declines and probably local extinction. Our findings clearly indicate that python observations have become much fewer and more sporadic in the past 25 years (Fig. 1). One reason why the Inland Carpet Python may have declined in areas where it was once common may relate to prey availability. One landholder noted that pythons disappeared shortly after populations of the European Rabbit *Oryctolagus cuniculus* declined following the introduction of myxomatosis, particularly after 1080 poison baits were used in the early 1970s (P

Sutherland pers. comm.). The European Rabbit can develop a resistance to myxomatosis (Kerr and McFadden 2002), and for this reason the species is still common in agricultural landscapes. However, 1080 baits also kill non-target species such as native rats *Rattus* sp. and possums (McIlroy 1982), which are prey items of pythons in general (Fearn *et al.* 2002). Thus, loss of prey abundance and variety may have contributed to declines in the Inland Carpet Python (Shine 1994).

Implications for fire planning

The majority of the records obtained in this study were from the upper Murray catchment. This region contains three large forest blocks that are managed by Parks Victoria and the Department of Environment and Primary Industries (formerly Department of Sustainability and Environment). Planned fires in these forest blocks occur on a regular basis to meet State targets (Recommendation 56: <http://www.royalcommission.vic.gov.au/Assets/VBRC-Final-Report-Recommendations.pdf>). Below, we review the relevant literature and outline key

recommendations to help guide fire planning in potential Inland Carpet Python habitat such as Granitic Hills Woodland.

Two studies have examined the effects of fire on pythons. One study on the Western Australian Carpet Python *M. s. imbricata* found that fire affects the species in complex ways depending on the intensity and extent of the burn (Pearson *et al.* 2005). For example, high severity fires can destroy hollow logs (shelter sites) but also promote dense shrub regeneration (habitat for prey). The second study on the Diamond Python from the east coast of Australia found time-since-fire and fire intensity had no influence on home range size (Michael *et al.* 2013). However, despite the paucity of investigations on the effects of fire on the Inland Carpet Python, known aspects of its ecology should be considered when planning fire in Granite Hills Woodland. These include: 1) use of arboreal habitats, 2) breeding locations, 3) thermoregulatory behaviour and 4) prey availability. We provide recommendations in relation to these topics in more detail below.

Two studies have found the Inland Carpet Python to be arboreal in late summer and autumn (Heard *et al.* 2004; Corey and Doody 2010). Corey and Doody (2010) also found that non-breeding females and juveniles tend to be more arboreal than adult males. When in trees pythons generally bask on exposed limbs or high within the canopy, and may remain in the same tree for several weeks (D Michael pers. obs.). Furthermore, breeding females incubate clutches of up to 25 eggs in either cavities below the ground (D Michael unpublished data) or within hollow logs between January and March (Heard *et al.* 2006). Thus, fires that are planned for the late summer to early autumn have the potential to consume canopy foliage and kill non-breeding females and juveniles. Fire during this period may also kill females brooding within hollow logs. To reduce the risk of habitat loss and mortality during the breeding season, we recommend that burns should be conducted in early spring or late autumn.

Successive changes in vegetation structure following high-intensity fire can influence the composition of reptile communities (Masters 1996; Lindenmayer *et al.* 2008; Smith *et al.* 2013). Soon after intense fire, species that re-

quire open habitats are favoured, whereas species that depend on unburnt habitat are disadvantaged. Regrowth vegetation (and correlated canopy cover) can also reduce solar penetration and hence the abundance of heliothermic reptiles (Michael *et al.* 2011). The Inland Carpet Python often basks in open places that receive high amounts of solar radiation (Shine 1994). High intensity planned burns that promote dense regrowth (thickets of vegetation) may reduce basking sites. Furthermore, planned burns which result in the removal of canopy foliage may increase terrestrial behaviour, which in turn may expose the species to greater risk of predation by introduced predators, such as the European Fox *Vulpes vulpes* (Heard *et al.* 2006). To reduce the risk of creating stands of dense regrowth, we recommend that planned burns are low intensity.

The Inland Carpet Python preys on a range of small to medium-sized mammals (Shine 1994), including introduced species such as the European Rabbit (Heard *et al.* 2004). Post-fire changes in the amount of habitat available can have a significant influence on mammalian prey (Fox and McKay 1981), especially hollow-dependent fauna such as possums and gliders (Gibbons and Lindenmayer 2002). Post-fire surveys of arboreal marsupials near Gerogery, NSW, indicate that the abundance of the Common Brush-tail Possum *Trichosurus vulpecula* and the Common Ring-tail Possum *Pseudocheirus peregrinus* can be significantly reduced (D Michael unpublished data). Hence, the loss of mature, hollow-bearing trees may have a long-lasting effect on the distribution and abundance of prey. To reduce the risk of losing hollow-bearing trees, we recommend the use of low intensity planned burns.

This study has highlighted the value of interviewing resident landholders to obtain historical information on a distinctive rare and cryptic species. Our findings suggest that pythons may have (or at least had) a much wider distribution than previously recognised, and further surveys are required to verify anecdotal sightings outside of the species' known range. In north-east Victoria, the conservation of the Inland Carpet Python will be enhanced by reducing potential risks associated with planned burning operations in Granitic Hills Woodland. Key manage-

ment recommendations based on the ecology of the species include implementing small-scale, low intensity fires during late autumn.

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First records of the sun moth *Synemon laeta* Walker, 1854 (Lepidoptera: Castniidae) from New South Wales

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Abstract

This article describes the first documented records of the sun moth *Synemon laeta* Walker, 1854 in the Pilliga State Conservation Area in New South Wales. This extends its known distribution by 285 km from the nearest previous record, Bendidee National Park near Goondiwindi, southern inland Queensland. (*The Victorian Naturalist* 132 (2) 2015, 44-48)

Keywords: *Synemon laeta*, sun moth, Castniidae, distribution, Pilliga forest

Introduction

The sun moths (family Castniidae) are a group of day-flying moths with a Gondwanan distribution (Common 1990). They have clubbed antennae and brightly coloured hind wings (similar to butterflies), and are often active only during the warmest part of the day (Common 1990; Zborowski and Edwards 2007). There are about 25 named species in Australia, all within the genus *Synemon* Doubleday, 1846, which is endemic to Australia (Common 1990; Edwards 1997). Many species have declined in range since European settlement and are now of conservation concern (O'Dwyer and Attiwill 1999; Douglas 2003; Douglas and Marriott 2003). The sun moth *Synemon laeta* Walker, 1854 (Figs. 1 and 2) has a wide distribution, known from the Cairns/Atherton area in northern Queensland and between Rockhampton and the Gold Coast and inland to Emerald and Goondiwindi in central to southern Queensland (Atlas of Living Australia 2014). It is common around the western parts of the Darling Downs and in Brisbane (ED Edwards, CSIRO, pers. comm. 2014). This contribution documents two sites from the Pilliga forest, in northern inland New South Wales (NSW), where the species has been recently recorded. These records constitute a southerly extension of the known range of the species and the first documented records in NSW.

The 450 000 ha Pilliga forest (30°25'–31°15'S, 148°40'–149°50'E) is located in Gamilaraay Aboriginal Country in the southern part of the Brigalow Belt South bioregion, on the western slopes of the Great Dividing Range in northern



Fig. 1. *Synemon laeta*, Ironbarks Crossing, Pilliga State Conservation Area, Pilliga forest. Photo by MJ Murphy.



Fig. 2. *Synemon laeta* (male), Dog Proof Fence Road, Pilliga State Conservation Area, Pilliga forest. Lodged in Australian National Insect Collection. The lines on the scale bar represent millimetres. Photo by You Ning Su (CSIRO).

inland NSW. The majority of native vegetation on more productive soils in the surrounding area has been cleared for agriculture, with the Pilliga forest left as a large woodland remnant on the poorest sandy soils (Murphy and Shea 2013). The forest comprises a mosaic of woodland and open forest communities with various *Eucalyptus*, *Angophora*, *Corymbia*, *Callitris*, *Allocasuarina* and *Acacia* species and is significant as one of the largest surviving woodland remnants in the Great Dividing Range western slopes bioregions. Pilliga State Conservation Area (SCA) is a 33 386 ha conservation reserve located on the flat outwash plain within the northern Pilliga forest.

Observations

Synemon laeta was recorded at two sites in Pilliga SCA during January/February 2014 (Fig. 3). All observations were made under hot and sunny conditions during a prolonged dry period. Site 1 (30°34.9'S, 149°12.2'E) (Fig. 4) was at Ironbarks Crossing, within 50 m of Cubbo Creek, an ephemeral stream in the Talluba

Creek catchment which was dry at the time of observation. The vegetation at the site was open forest comprising White Cypress Pine *Callitris glaucophylla*, Buloke *Allocasuarina luehmannii* and an unidentified species of Red Gum *Eucalyptus* sp., with a sparse ground cover. The vegetation along the nearby creek was open forest of Rough-barked Apple *Angophora floribunda* and Red Gum. About six *Synemon laeta* were seen at site 1 in the mid afternoon of 1 January 2014, flying around rapidly within about 1 m of the ground, chasing each other and alighting on vertical dry grass stems and sticks. On landing, the moths briefly held the forewings up, exposing the colourful hindwings, before folding them into the 'tent' or 'roof' position in which the hindwings were covered by the forewings (see Fig. 1). Activity was centred on a roadside area of bare ground with sparse dry grass (shown in the foreground of Fig. 4). The sun moths generally flew within about a 15 m radius of this area before returning to settle again within a few metres. Two specimens were collected, of which one was lodged in the Australian Museum (Syd-



Fig. 3. Location of *Synemon laeta* records in the Pilliga forest, northern inland NSW. The shaded area shows the Pilliga forest.

ney) and the other in the Australian National Insect Collection (ANIC) (Canberra). The site was revisited on 7 February 2014 and two *Synemon laeta* were observed at 1400 h Australian Eastern Daylight Time (AEDT), one of which was photographed (Fig. 1).

Site 2 (30°30.1'S, 149°24.0'E) (Fig. 5) was 21 km ENE of site 1 on Dog Proof Fence Road. The site was a dry ephemeral drainage line in the Coghill Creek catchment with open forest of Red Gum, Rough-barked Apple and Tea Tree *Leptospermum polygalifolium* and a dry tussock ground cover comprising a species of mat rush *Lomandra* sp. About 50 m from the site the vegetation changed to woodland of Narrow-leaved Ironbark *Eucalyptus crebra*, White Cypress Pine and Buloke with a sparse ground cover. A single *Synemon laeta* was observed at 1445 h AEDT on 7 February 2014, fluttering within 1 m of the ground and perching on vertical dry mat rush stems on the roadside. The specimen was collected and lodged in the ANIC (Fig. 2).



Fig. 4. Habitat at site 1 (Ironbarks Crossing). Photo by MJ Murphy.

Discussion

The Pilliga forest records of *Synemon laeta* documented here are located 285 km from the nearest previous record in Bendidee National Park near Goondiwindi, southern inland Queensland (Atlas of Living Australia 2014), and comprise the first documented records of the species from NSW (ED Edwards pers. comm. 2014). The species has previously been recorded less than 10 km from the NSW border in the South Eastern Queensland bioregion (in Lamington National Park and at Burleigh Heads) (Atlas of Living Australia 2014) and may also occur in adjacent areas of the NSW north coast.

The Brigalow Belt South bioregion extends about 500 km north of the NSW/Queensland border, and the occurrence of *S. laeta* in the Pilliga forest is an example of a northerly (Torresian) faunal component in the area. Other examples of this 'northern' fauna in the Pilliga forest include the freshwater crab *Austrohelphusa transversa*, the hyriid mussel *Velesunio*

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Ash-grey Mouse *Pseudomys albocinereus*, Nambung NP, Cervantes WA. Photo by John Harris, Wildlife Experiences P/L.



Fig. 5. Habitat at site 2 (Dog Proof Fence Road). Photo by MJ Murphy.

wilsonii, the pupillid land snail *Gastrocopta hedleyi*, Northern Banjo Frog *Limnodynastes terraereginae*, Golden-tailed Gecko *Strophurus taenicauda*, Red-winged Parrot *Aprosmictus erythropterus* and Delicate Mouse *Pseudomys delicatulus* (Date *et al.* 2002; Breed and Ford 2007; Murphy 2008; Murphy 2011; Brown *et al.* 2012; Murphy and Shea 2013).

The months recorded for adult *Synemon laeta* in the Pilliga forest fall within those recorded near Leyburn, Queensland (340 km NE of the Pilliga forest), where adults were recorded flying from late December to mid March (Dunn 1996). The site fidelity by perching sun moths seen at site 1 in the Pilliga forest is in contrast to the behaviour described by Dunn (1996), where disturbed sun moths settled 10 m or more from their original perch. The occurrence of *Lomandra* sp. at site 2 is of interest because the larvae of *S. laeta* are associated with *Lomandra confertifolia* and *L. longifolia* on which they are thought to feed underground on the rhizomes (Dunn 1996; Edwards 1997).

Other sun moth species which occur in NSW include *Synemon collecta* (grassy woodlands on the northern tablelands), *Synemon jcaria* (mallee woodland in central inland NSW), *Synemon magnifica* (open sandstone areas on the coast and ranges), *Synemon plana* (native grassland on the southern tablelands) and an undescribed *Synemon* species (Snowy Mountains) (O'Dwyer and Attiwill 1999; Douglas 2003; Zborowski and Edwards 2007; Richter *et al.* 2013; Atlas of Living Australia 2014; ED Edwards pers. comm. 2014). *Synemon laeta* is the only sun moth currently known from the Pilliga forest. Many sun moth species and other insects dependent on woodlands have declined due to loss, alteration and fragmentation of their habitat (Douglas and Marriott 2003; Douglas 2005; New *et al.* 2007). The occurrence of *Synemon laeta* in the Pilliga forest is further evidence of the significant biodiversity conservation value of this extensive woodland remnant within the agricultural landscape of the western slopes of NSW.

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First record of the crawling medusa *Eleutheria dichotoma* from Victoria

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Abstract

This is the first record of the crawling hydrozoan medusa *Eleutheria dichotoma* from the plankton at Queenscliff, Victoria. The species was recorded in 2006 from coastal, intertidal habitat in New South Wales. (*The Victorian Naturalist* 132 (2) 2015, 48–50)

Keywords: crawling medusa, *Eleutheria dichotoma*, hydrozoan medusa, Queenscliff

Introduction

Two specimens of a marine hydromedusa were recovered from plankton tows in the Fishermens Cut, Queenscliff, Victoria in May 2014. The specimens were identified as the crawling medusa, *Eleutheria dichotoma*, which is one of a small group of hydrozoan medusae that crawls on algae rather than swimming in the plankton. The Queenscliff specimens were photographed in the laboratory under a Leica MZ12 stereomicroscope, using a (Point Grey) digital camera. The medusae survived for 10 days in the laboratory before disintegrating.

Systematics

Family Cladonematidae Gegenbauer, 1857

Genus *Eleutheria* Quatrefages, 1842

Eleutheria dichotoma Quatrefages, 1842

Figs. 1 and 2.

Bouillon *et al.* 2004: 89, Fig. 48G–H. - Fraser *et al.* 2006: 699, Fig. 2A–H. - Schuchert 2006: 381,

Fig. 19A–C.

Diagnosis

Hydroid: stolonial, hydranth 1–6 mm high, with very short pedicel, perisarc smooth. Hydranth

almost cylindrical, with an oral whorl of four to eight capitate tentacles. Medusa buds borne low on hydranth. *Medusa:* width 4–5 mm across extended tentacles, umbrella flattened hemispherical, oral surface more or less six-sided with thickened marginal ring packed with nematocysts. Velum broad and almost closed, opening only when feeding. Manubrium broad, filling most of subumbrella cavity, mouth simple. Usually six radial canals, gonads on manubrium. Tentacles usually five to six, bifurcated about middle, upper branch with terminal nematocyst cluster, lower branch terminating in an adhesive pad armed with stenotele and desmoneme nematocysts. An ocellus at base of each tentacle. Secondary medusae budding from bell margin.

Remarks

Microscopic examination and digital images of the Queenscliff specimens confirmed them as *Eleutheria dichotoma*. As the specimens did not survive there is no voucher material. Further plankton tows produced no other specimens.

One medusa had eight tentacles, a reddish ocellus at the base of each tentacle and a new tentacle growing from the side of the bell (Fig. 1). A second specimen had 12 tentacles; although not visible in the image, ocelli were present in the living specimen (Fig. 2).

The intertidal and shallow water cosmopolitan green alga, *Ulva lactuca*, is the favoured habitat of *Eleutheria dichotoma* (Fraser *et al.* 2006 and pers. obs.); this alga is common in the Queenscliff Boat Harbour and adjacent Swan Bay. The species is well known from the northern hemisphere where it has been recorded from depths to 20 m in the Mediterranean Sea (Brinkmann-Voss 1970). The small hydranth is seldom found in nature and is known mostly from aquarium studies. The medusa is easily

identified by the dichotomously branched tentacles with terminal pads of nematocysts.

The medusa was recently recorded for the first time in the southern hemisphere on intertidal platforms from Bateau Bay to Pebbly Beach on the central-southern New South Wales (NSW) coast. It was abundant on *Ulva*, the brown alga *Sargassum* and corallines, with population densities averaging 52 individuals/10 cm² of substrate (Fraser *et al.* 2006). Molecular analysis of the NSW specimens showed a close relationship with *E. dichotoma* from the Mediterranean Sea, differing by as little as 0.4% (Fraser *et al.* 2006).

Although both Queenscliff specimens possessed more tentacles than reported for some European and NSW medusae the number is considered variable and not diagnostic of the



Fig. 1. *Eleutheria dichotoma* with eight bifurcate tentacles, with terminal nematocyst clusters, one tentacle bud (right hand side) and a red ocellum at base of each tentacle; bell diameter is 0.38 mm.

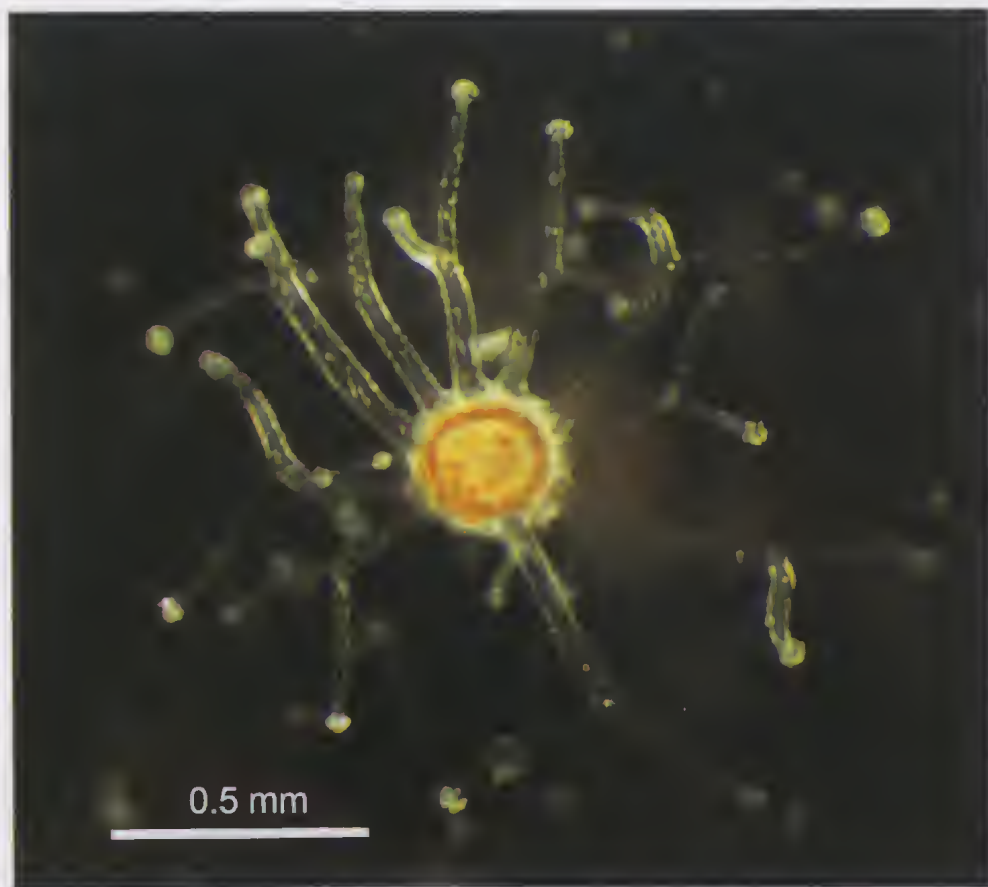


Fig. 2. *Eleutheria dichotoma* with 12 bifurcate tentacles (10 tentacles are shown, 2 others are folded out of the focal plane); bell diameter is 0.3 mm.

species (see Schuchert 2006; Brinckmann-Voss, pers. comm.). The actual number of tentacles is probably determined by ecological factors. As Briggs (1920, 1931) made no mention of *E. dichotoma* in his extensive studies of crawling medusae from NSW and Watson and McInnes (1999) did not find it among intertidal algae from Black Rock in Port Phillip, it is likely to have been introduced to southern Australia over past decades, probably in ships' ballast water.

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Further notes on the welfare of small mammals captured during pitfall trapping

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Abstract

Researchers conducting trapping surveys of vertebrate fauna are required to use a range of measures to ensure the wellbeing of captured animals. These include procedures to protect small mammals captured during pitfall trapping. Various materials can be placed in pitfall traps to provide shelter for small mammals, especially those captured overnight. During long-term studies at three sites in southern and western Victoria, two species of small marsupials used polystyrene cups that were placed in pitfall traps for shelter. (*The Victorian Naturalist* 132 (2) 2015, 51–53)

Keywords: pitfall traps, polystyrene cups, Eastern Pygmy Possum, Swamp Antechinus

Introduction

National guidelines set broad parameters for the ethical use of wildlife during field studies (Australian Government 2013). Animal ethics committees require researchers conducting field studies of vertebrate fauna to produce and use more detailed procedures to protect the welfare of captured animals (Petit and Waudby 2012). Pitfall trapping, a survey method commonly used to detect the presence of reptiles and amphibians (Cogger 2014), also produces captures of small mammals (Menkhorst and Knight 2011). Small refuges may be placed in pitfall traps to provide shelter for those captured overnight.

The Eumeralla section of the Great Otway National Park (Eumeralla) (38°23'S, 144°12'E) is situated near Anglesea approximately 90 km south-west of the Melbourne CBD. Surveys of vertebrate fauna have been conducted at this site by RMIT University since 2004 (RMIT University unpubl.) and by Holmesglen Institute since 2006 (Homan unpubl.). The Wonthaggi Heathlands Nature Conservation Reserve (WHNCR) (38°38'S, 145°35'E) is situated approximately 104 km south-east of the Melbourne CBD. RMIT University has conducted surveys of vertebrate fauna at this location since 2007 (RMIT University unpubl.). Wuurak Land for Wildlife property, Moyston West (37°18'S, 142°41'E) is situated approximately 210 km west of the Melbourne CBD. Surveys of vertebrate fauna have been conducted at this property since

2004 (Homan 2012, 2014). Pitfall trapping was a survey method used during these studies and a 245 ml polystyrene take-away coffee cup was placed in each pitfall bucket as shelter for captured mammals.

Field studies at WHNCR during 2001 and 2002 produced numerous records of White-footed Dunnart *Sminthopsis leucopus*, Swamp Antechinus *Antechinus minimus* and House Mouse *Mus musculus* using polystyrene cups as shelter in pitfall traps (Homan 2004). This paper provides additional records of small marsupials using polystyrene cups during pitfall trapping at the above three sites over the last ten years. These records provide further evidence that artificial refuges can play an important part in ensuring the well-being of small mammals captured during pitfall trapping.

Further records of small mammals using polystyrene cups as shelter in pitfall traps Eumeralla section, Great Otway National Park

23 February 2006: One adult female Swamp Antechinus (34 g) captured overnight.

4 October 2006: One adult female Swamp Antechinus (32 g) captured overnight.

16 October 2007: One adult male Eastern Pygmy Possum *Cercartetus nanus* (20 g) captured overnight.

2 September 2008: One sub-adult male Eastern Pygmy Possum (14 g) (Fig. 1) captured overnight.

4 March 2014: One adult male Swamp Antechinus (39 g) and one adult female Eastern Pygmy Possum (20 g) captured overnight in the same pitfall trap and sharing the same polystyrene cup when traps were checked at dawn. This Swamp Antechinus, which had a distinctive broken tail, was recaptured two days later when it also used the polystyrene cup in a different pitfall bucket.

Wonthaggi Heathlands Nature Conservation Reserve.

9 October 2013: One adult female Swamp Antechinus (49 g) found in cup when traps checked at noon.

Wuurak Land for Wildlife Property.

2 April 2014: One sub-adult male Eastern Pygmy Possum (12 g) captured overnight.

Discussion

Standard Operating Procedures used by educational institutions, field naturalist clubs, wildlife consultants and other investigators are designed to provide a clear set of measures to ensure the well-being of animals used during field studies (Petit and Waudby 2012). In particular, stud-

ies that involve live trapping are expected to be conducted using a comprehensive set of ethical procedures. Welfare measures used during pitfall trapping may include external rain and shade covers, checking traps carefully and in a timely fashion and providing vegetation and small refuges in each pitfall trap (Hobbs and James 1999; Thompson and Thompson 2009; Petit and Waudby 2012).

Various artificial materials have been suggested as suitable refuge shelters in pitfall buckets. These include cardboard tubing, sections of cardboard egg cartons, pieces of folded cardboard, PVC tubing, transparent plastic tubing, polystyrene discs and insulation foil (Hobbs and James 1999; Pestell and Petit 2007; P Robertson pers comm. 10 April 2014). In other instances natural materials consisting of strips of bark have been used (Pestell and Petit 2007). Polystyrene cups have also been used as shelters during pitfall trapping (Homan 2004; P Robertson pers. comm. 10 April 2014; Fauna Survey Group, FNCV unpubl.). Some refuges such as cardboard tubes and other cardboard materials have the disadvantage of absorbing moisture



Fig. 1. Eastern Pygmy Possum in polystyrene cup, Eumeralla, 2008. Photo Graeme Eames.

and promoting fungal growth in certain circumstances (Petit and Waudby 2012). Polystyrene cups, however, have the advantage of being waterproof and also provide good insulation.

During surveys at Eumeralla, 713 pitfall trap-nights were completed between 2004 and 2014 (RMIT University unpubl.; Homan unpubl.). Nine small mammals were captured in pitfall traps during these surveys, with six of these (66%) using polystyrene cups. Individuals found outside cups included a sub-adult Swamp Rat *Rattus lutreolus* and an adult Swamp Antechinus in separate buckets in October 2006 and a House Mouse in March 2012. The recording of an Eastern Pygmy Possum and a Swamp Antechinus in the same cup at Eumeralla in March 2014 was unexpected. Sharing of a cup by different species has been recorded by the author on only one other occasion. At WHNCR in 2002, a White-footed Dunnart and a House Mouse were found in the same polystyrene cup (Homan 2004). At WHNCR, 374 pitfall trap-nights were completed between 2007 and 2013, resulting in one mammal capture mentioned above. At Wuurak LFW property, 230 pitfall trap-nights were completed between 2004 and 2014. These produced two captures of Eastern Pygmy Possum, one found inside the cup (mentioned above) and one outside the cup (Homan 2012). Although no evidence such as scats or hairs were found, it is possible that all individuals found outside cups at dawn may have used the cups at some time during the night and vacated cups only when they heard investigators approaching pitfall buckets.

Other studies have involved the provision of various types of shelters including polystyrene cups in pitfall traps. During surveys in far East Gippsland an adult Eastern Pygmy Possum (September 2003) and an adult female Dusky Antechinus *Antechinus swainsonii* (September 2006) used polystyrene cups that had been provided in pitfall buckets (FNCV unpubl.). Pestell and Petit (2007) completed 2606 pitfall trap-nights at Innes National Park in South Australia, resulting in 78 captures of Western Pygmy Possum *Cercartetus concinnus*. Whilst polystyrene cups were not used during that study, 39 individuals (50%) used the shelters provided which included natural and artificial materials.

During the studies at Eumeralla, WHNCR and Wuurak external covers were placed over pitfall buckets each night and also when it rained during the day. A layer of vegetation was placed in the bottom of each pitfall trap and traps were checked at dawn, midday and late afternoon. No trap-deaths occurred during these surveys, possibly due to the welfare measures used. Whilst these studies produced relatively few records of mammals captured in pitfall traps, they nevertheless provide further evidence that polystyrene cups can provide ideal refuges for small mammals captured during pitfall trapping.

Acknowledgements

Surveys at the three sites were conducted under the terms of numerous research permits issued by the Department of Sustainability and Environment and the approval of Animal Ethics Committees of the Department of Primary Industries and RMIT University. Many thanks to Peter Robertson, Wildlife Profiles Pty Ltd, for his comments on pitfall refuges.

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Reptiles & amphibians of Australia

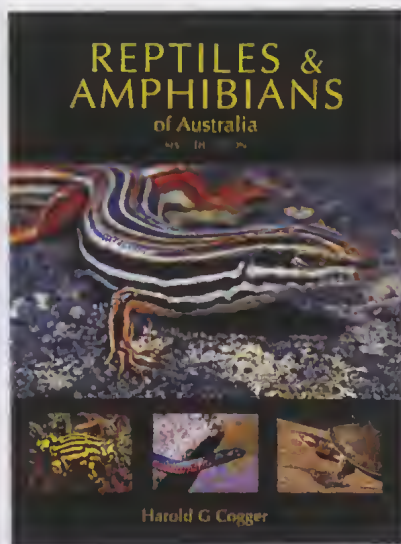
by Harold G Cogger

Publisher: CSIRO Publishing, Collingwood. 2014. 1056 pages, hardcover, colour photographs, monochrome technical drawings, ISBN 9780643100350. RRP \$150

A clear sign that a book is the definitive work on a subject is when it is recognisable solely by the surname of the author. Since 1975, herpetologists (those who study herpetofauna—reptiles and amphibians) have fondly reached for their ‘Cogger’ when they require the definitive guide to the identification of Australian reptiles and frogs. The original ‘Cogger’ covered 664 species, whereas this, the seventh edition, details 1218 species, and that number continues to climb due to the methodical work of taxonomists.

This book occupies a particular and treasured place in the literature on Australian herpetofauna, and earlier editions are now collectors’ items. The niche filled by *Reptiles & Amphibians of Australia* is clearly enunciated in the Preface: ‘the primary aim of this book is to provide the means to identify the majority of reptiles and frogs found in continental Australia and Tasmania’ (p. xxvi). Some new books overlap somewhat in both content and intent: Marion Anstis’ *Frogs and Tadpoles of Australia* is now the pre-eminent text on Australian amphibians, and the latest edition of Steve Wilson and Gerry Swan’s *A Complete Guide to Reptiles of Australia* is an affordable, compact field guide for the country’s reptiles. Like Anstis’ book, Cogger’s latest offering is *not* a field guide; it is intended to be a desk-based, authoritative identification guide. It primarily uses dichotomous keys (often accompanied by high-quality technical drawings) to identify individuals to species level, and then provides a comprehensive account of each species in terms of distinguishing characteristics, but only brief details of distribution and habits.

The vast majority of accounts for each species are accompanied by an attractive colour photograph and a distribution map using the



whole of Australia (which therefore means detail is limited). Where a common name exists, it is provided beneath the scientific name. The bulk of the text in each account is a detailed description specifying size, colour pattern (and variation), and diagnostic features such as scale arrangements and counts for reptiles, skin features for frogs, and relevant aspects of other morphological features. Where known, a description of the advertisement call of each frog is also provided.

I believe a necessity in any book on Australian reptiles is a guide to first aid for snakebite. Not only are the basics of first aid covered, but also an explanation of the major components of the venom of Australian elapid snakes. In an era when new species are being described just as others are facing premature extinction, another relevant topic in this book is conservation. Reptiles and frogs tend to fare poorly in human affections compared to mammals and birds, and this unpopularity too frequently results in failure to protect their habitat—a problem exacerbated by other threats such as predation rates being elevated by exotic carnivores, and the impacts of disease (particularly for frogs affected by the devastating disease chytridiomycosis). Cogger’s eminent voice is always a welcome contribution to conservation advocacy for Australia’s herpetofauna.

Other topics described in this book include: patterns of reptile and frog distribution, locating specimens for photography or authorised capture, methods for collecting/sampling, transporting live animals, killing and preservation of specimens, care of captive specimens, and introduced (exotic) reptiles and amphibians. Although not known by Cogger at the time of writing, it is interesting to note that an exotic amphibian (the European newt *Lissotriton vulgaris*) has apparently become established in Victoria (Tingley *et al.* in press), adding some local relevance to the concerns raised in this section. A very useful feature of this book is one of the most comprehensive and relevant glossaries in the herpetological literature.

This is a large and attractive book. Its content has been refined and updated over nearly 40 years, and it remains the definitive identification guide to Australian herpetofauna. No herpetologist's bookshelf is complete without a 'Cogger'; it provides the descriptive detail that underpins the growing literature on the nation's reptiles and frogs.

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Nick Clemann

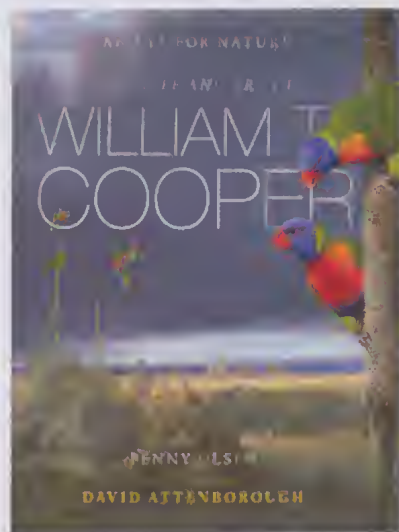
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An eye for nature: the life and art of William T Cooper

by Penny Olsen,
foreword by David Attenborough

Publisher: National Library of Australia, Canberra,
2014, x, 278 pages, hardback, coloured illustrations.
ISBN 9780642278463. RRP \$49.99

An eye for nature: the life and art of William T Cooper is a high quality production, comprising Penny Olsen's entertaining, informative, carefully researched account of William T Cooper's life and career, as well as about 200 reproductions of Cooper's superb paintings and drawings, and numerous photographs. The foreword, written by David Attenborough (who judges Cooper to be 'the best ornithological illustrator alive') is, appropriately, accompanied by a reproduction of Cooper's stunningly beautiful painting of Lesser Birds-of-paradise. (When Cooper and Attenborough were boys, both were inspired by seeing an illustration of these fascinating birds.) At the back of the book are two portfolios of previously unpublished paintings, one of birds, the other of landscapes. These are followed by a bibliography, a list of



Cooper's publications, and a very useful index. The *Rainbows on the Moor* and text on the dust jacket are also printed on the hard cover, so if anything happens to the dust jacket almost all its content will remain with the book.

Cooper has always had an interest in nature—an interest encouraged by both his parents. He grew up in the Newcastle area, where there were plenty of opportunities to explore the bush, learn bushcraft from his father, go fishing, and observe animals and plants. His mother taught

him to sketch, and he began to win prizes at an early age. He left school at 15, and did many odd jobs before becoming a window dresser, an occupation that allowed him to use his artistic talent painting backdrops for displays of merchandise. From the 1950s he entered and won prizes in art competitions, thus coming in contact with other artists, including William Dobell who gave him sound advice and introduced him to art dealers.

Today, Cooper is perhaps best known for his paintings of birds, especially those featured in books produced in collaboration with Joseph Forshaw, such as *Parrots of the World*, *The Birds of Paradise and Bower Birds*, *Australian Parrots*, *Kingfishers and Related Birds*, and *Turacos*. However, he has also painted many breathtaking pictures of a host of other animals, has travelled widely to observe his subjects in their natural surroundings, and is equally skilled in botanical illustration. His eye for detail, commitment to accuracy, and instinct for perfect composition are extraordinary.

After reading this book I am amazed that Cooper is still alive, for this remarkable artist has had many arduous and often hair-raising adventures in various parts of the world—or, as

Penny Olsen writes, 'many close shaves in pursuit of subject matter' (p. 217). During a trip to Bukit Fraser in Malaysia, for example, Cooper's driver dozed off and the car rolled down a steep hillside and hit a tree. Even here in Australia he has experienced the wrath of a male Southern Cassowary protecting his chicks from the perceived threat of a human.

There are very few faults in this book, though I was somewhat startled to see an elephant referred to as a mammoth (p. 137), and Cooper's mother's maiden name given as Cooper (p. 155) instead of Bird.

This is a most impressive book, well written, splendidly illustrated and beautifully presented. It is also an important contribution to the record of Australia's cultural heritage. At \$49.99 it is a bargain. Your interest will be aroused right from the beginning, for on the title page there is a reproduction of a painting of a domestic cat, which the caption overleaf describes as 'The infamous cat that nearly wrecked Cooper's career'. Now read on!

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One Hundred Years Ago

Wanderings on the Murray flood-plain

By J.G. O'DONOHUE

In making our first inspection of [Lake] Mournpoul, we noted that, though its area had been reduced to a considerable extent by the abnormal spell of dry weather then prevailing, there were still between 500 and 600 acres covered with water, which in some parts of the lake was estimated to have a depth of twelve feet. The lake is practically encircled by sand-dunes of varying elevations, and overflows to the north-east and south-east. Its shores are flat, and sandy in the vicinity of the dense growth of Red Gum and box timber growing on and at the base of the sand-dunes, but are extremely muddy near the water's edge. The introduced tobacco flourishes in places, and, from the appearance of many upright, decayed stems of the plant far out in the water, seems to have had a more extensive range on the lake bed than at present. The only other plant noted on the shores was the Small Knotweed, *Polygonum plebejum*. This forms, in favourable situations, a dense sward, which is kept closely cropped by the cattle, sheep, and emus.

From *The Victorian Naturalist* XXXII, pp. 19-20, May 6, 1915

The sixth extinction: an unnatural history

by Elizabeth Kolbert

Publisher: Bloomsbury, 2014, paperback, 319 pages, ISBN 9780805092998, RRP \$29.99

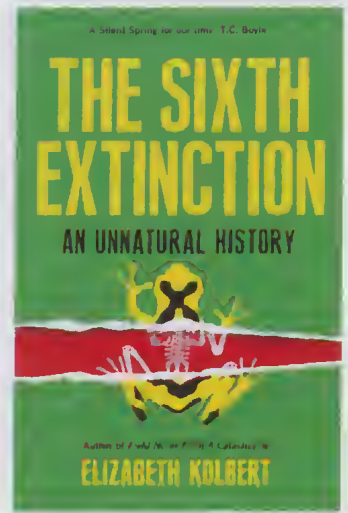
Recently I went on a journey. My final destination was Wuhan, China, but initially I travelled to Panama, to the town of El Valle De Anton. It was only my second trip to Central America; my first was to Leon, Nicaragua just two years prior, and on the flight I imagined colourful market places with volcanoes dotting the horizon.

My guide in El Valle was Elizabeth Kolbert, who took me to the El Valle Amphibian Conservation Center (EVACC), in the middle of a volcanic crater. I was introduced to the scientists working at EVACC, and taken on a field trip where I learnt about the plight of the Panamanian golden frog *Atelopus zeteki* and other amphibians in Central America. For over a decade amphibians across America have been affected by a chytrid fungus that interferes with their ability to take up critical electrolytes through their skin. 'This causes them to suffer what is in effect a heart attack'.

It appears there are two main theories as to how the chytrid fungus has spread so quickly through Central America; one is through the global shipments of African clawed frogs and the other is through the export of North American bullfrogs, both of which have a tolerance for the fungus. The fungus has led to the widespread demise of amphibian populations and the extinction of species.

Kolbert indicated that a similar situation is happening in Australia too. On further investigation I came across an example, research demonstrating that the same species of amphibian chytrid fungus found on skin swabs of two species of corroboree frogs in the Australian Alps was believed to be responsible for the amphibians' declining populations (Hunter *et al.* 2010).

My journey continued to Italy, the Arctic, Sumatra, and the depths of the ancient Iapetus Ocean, all in the pages of Kolbert's book



The sixth extinction: an unnatural history that I was reading en route. In the book Kolbert takes the reader on a journey through space and time, and fills her narration with historical anecdotes, interesting adventures of the rigours of travel in remote localities, interviews with leading scientists, and home again to the familiarity of the reader's own backyard.

Kolbert's background in journalism is evident in the style of her writing. I enjoyed the travelogue style, which was very similar to the articles I could read in the inflight magazines. But it is a rather morbid tale of death and demise that focuses on the effects our own species is having on the distribution and diversity of organisms on our planet. A tale created by people just like me travelling around the world or sitting at home in the comfort of their armchair with the gas central heating on, ordering goods from overseas.

The book appealed to my broad interests in history, geography, biology, geology and palaeontology. It is suitable for a wide range of general readers, and provides a snapshot of examples from around the world that students could research further to use as examples for case studies or essays in biogeography, biodiversity, ecology, environmental studies, or history of life. I enjoyed travelling back in time to the plummeting temperatures affecting life in the Earth's oceans during the latter part of the Ordovician (approximately 444 million years ago),

resulting in the second largest mass extinction of all time. It was an extinction event that didn't involve me, just a set of naturally changing environmental conditions that changed the biological components of the world. This was the type of extinction event that I was used to reading about. But what stood out in every chapter of this book was a different way that humans were implicitly or explicitly creating a sixth mass extinction today. This was not so enjoyable to contemplate, but very necessary to the narrative and purpose of the book.

So on arrival in Wuhan, with only a chapter or two to go, I pondered on the carbon footprint of my flight and what fungi, bacteria and viruses I might have unknowingly brought into the country. Also during my stay I was constantly reminded of the changes we make to the

world, with signs displaying the slogan 'Wuhan, changing everyday'. Consequently, before my flight home I took the hotel toothbrush and scrubbed the soles of my shoes, the rocks and fossils I'd collected on my journey, vigorously cleaning any last traces of mud from the surface, leaving a grimy sink behind.

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Little Pygmy Possum *Cercartetus lepidus*, Murray Sunset National Park. Photo John Harris, Wildlife Experiences P/L.

Climate change adaptation plan for Australian birds

by Stephen Garnett and Donald Franklin

Publisher: CSIRO Publishing, Melbourne 2014.
paperback, 272 pages,
ISBN 9780643108028, RRP \$69.95

The two basic strategies to assist species deal with climate change are mitigation (reduction of warming by reducing emissions of greenhouse gases) and adaptation (helping create opportunities for species adapting to new circumstances). It is the latter which is the focus of this book, and it is heartening that we are starting to move the discussion on climate change to what can be done, rather than to simply describe the problem, as was the case a decade ago (see Chambers *et al.* 2005). Indeed, CSIRO Publishing indicates that this is the first climate change adaptation plan for a faunal group at the national level. I agree it is a major, considered body of work which makes a major contribution to managing biodiversity on a changing globe. Further, and perhaps more importantly, it outlines a conceptual approach for adaptation planning which will doubtlessly be used outside Australia, and which will be refined over time. Refreshingly, it also acknowledges uncertainties, and the pitfalls of making predictions.

This book is not light reading! While I think that conservation biologists, policy makers and others will use this book as a resource, few non-scientists are likely to appreciate it despite its clear and readable style. It is heavy on science (e.g. spatially explicit and complex models of species' exposure to climate change). The book identifies a set of species (marine and terrestrial) especially exposed and sensitive, and therefore vulnerable, to the effects of climate change (but does not claim to present a comprehensive list of vulnerable species). While it specifies meaningful, useful, best-available conservation actions for this set of species (based on a transparent conceptual approach), these sometimes sound hollow in comparison with the challenge faced by birds in the face of climate change.



This is not the fault of the book, but rather the magnitude of the challenge that climate change presents to managers of birds. Costings on the recommended actions are also provided in the species profiles, perhaps sharpening attention of decision-makers on the economic costs of climate change.

The book is written by different groups of authors as a series of chapters, each with its own reference list (which consumes space and leads to a somewhat jolting experience to the reader). The data used are from continental-scale citizen science projects (i.e. the bird atlases), thus the book capitalises on the versatility and massive contribution that such efforts make to conservation and conservation science. The spatially explicit modelling is usefully presented in colour.

One cannot 'enjoy' the subject matter of books such as this, but I enjoyed the clear conceptual framework, expert execution of the science, and appropriate cautions embedded in the work. This book may well be a landmark on the international stage, and will be much cited as the world grapples with how to help species survive a warming planet.

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